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COMPUTATIONAL ACOUSTICS

N00014-88-K-0264

February 1, 1988 - January 31, 1990

Final Technical Report

February 8, 1992

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General Goal: To develop accurate and efficient numerical models of the acoustic propagation problem. The main considerations were: long range propagation, short range propagation, one-way outgoing or incoming (no backscatter - PE's), two-way (backscatter - Elliptics), and liquid/solid interface.

General Approach: To model physical phenomena using partial differential equations and to apply modern numerical methods of scientific computing to their solution. The main considerations were: stability, convergence, accuracy, efficiency, error estimates, well-posedness, and applicability.

Results Were Obtained on the Following Topics:

- 1.) Higher Order Parabolic Methods,
- 2.) Error Estimates in PE's,
- 3.) Higher Order PE Equations with Density - Interface considerations,
- 4.) Elliptic Models, Backscatter, Marching,
- 5.) Elliptic Marching, $L1 \circ L2(u) = g(r, u)$,
- 6.) IFD-Shear, Liquid/Solid Interface.

Results: Seven scientific papers were written and eleven (St. Mary associated) scientific presentations were made.

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Scientific Papers:

1. Accurate computation of the wide angle wave equation, *Computation Acoustics: Wave Propagation, Proceedings of the 1st IMACS Symposium on Computational Acoustics*, D. Lee, R.L. Sternberg, M.H. Schultz editors, 1, Elsevier Science Publishing Co., INC., North Holland, New York, 409-422 (1988) (with D. Lee).
2. Marching methods for elliptic models of underwater sound propagation. *Computation Acoustics: Wave Propagation, Proceedings of the 1st IMACS Symposium on Computational Acoustics*, D. Lee, R.L. Sternberg, M.H. Schultz editors, 1, Elsevier Science Publishing Co., INC., North Holland, New York, 397-407 (1988) (with G.H. Knightly).
3. Accuracy of computational methods of underwater sound propagation, *Proceedings 12th IMACS World Congress, July 18-22, 1988, Paris*, R. Vichnevetsky, P. Borne, J. Vignes, editors, IMACS, Paris, 2, 234-236 (1988) (with G.H. Knightly, D. Lee).
4. Analysis and computation using higher order parabolic equations that include density variations, *Proceedings 12th IMACS World Congress, July 18-22, 1988, Paris*, R. Vichnevetsky, P. Borne, J. Vignes, editors, IMACS, Paris, 2, 237-240 (1988) (with G.H. Knightly, D. Lee).
5. Analysis of the accuracy of a computational method for the parabolic wave equation, *Numerical and Applied Mathematics*. W. F. Ames (ed.), J.C. Baltzer AG, Scientific Publishing Co., IMACS, 329-334 (1989) (with G.H. Knightly, D. Lee).
6. Derivation and discretization of parabolic equations containing arbitrary density functions, *Numerical and Applied Mathematics*. W. F. Ames (ed.), J.C. Baltzer AG, IMACS, Scientific Publishing Co., IMACS, 323-328 (1989) (with G.H. Knightly, D. Lee).
7. Computational ocean acoustics, to appear *Proceedings of the Second Edward Bouchet Conference on Physics and Technology*, Accra, Ghana, 99-108, 1990 (with G. H. Knightly).

Statement A per telecon
Dr. Marshall Orr ONR/Code 1125
Arlington, VA 22217-5000

NWW 3/19/92

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REPORT OF INVENTIONS AND SUBCONTRACTS

(Pursuant to "Patent Rights" Contract Clause) (See Instructions on Reverse Side)

Form Approved
OMB No. 0704-0297
Expires Jun 30, 1992

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1a. NAME OF CONTRACTOR/SUBCONTRACTOR University of Massachusetts	c. CONTRACT NUMBER N00014-88-K-0264	2a. NAME OF GOVERNMENT PRIME CONTRACTOR SAME as 1a.	c. CONTRACT NUMBER SAME as 1c.	3. TYPE OF REPORT (X one) a. INTERIM b. FINAL
b. ADDRESS (Include ZIP Code) Grant & Contract Admin. Amherst, MA 01003	d. AWARD DATE (YYMMDD) 02/01/88 - 01/31/91	b. ADDRESS (Include ZIP Code) SAME as 1b.	d. AWARD DATE (YYMMDD) SAME as 1d.	4. REPORTING PERIOD (YYMMDD) a. FROM b. TO

SECTION I - SUBJECT INVENTIONS

5. "SUBJECT INVENTIONS" REQUIRED TO BE REPORTED BY CONTRACTOR/SUBCONTRACTOR (If "None," so state)

a. NAME(S) OF INVENTOR(S) (Last, First, MI)	b. TITLE OF INVENTION(S)	c. DISCLOSURE NO. PATENT APPLICATION SERIAL NO. OR PATENT NO.	d. ELECTION TO FILE PATENT APPLICATIONS (1) United States (a) Yes (b) No (2) Foreign (a) Yes (b) No	e. CONFIRMATORY INSTRUMENT OR ASSIGNMENT FORWARDED TO CONTRACTING OFFICER (1) Yes (2) No
NONE	NONE			

1. EMPLOYER OF INVENTOR(S) NOT EMPLOYED BY CONTRACTOR/SUBCONTRACTOR	g. ELECTED FOREIGN COUNTRIES IN WHICH A PATENT APPLICATION WILL BE FILED (1) Title of Invention (2) Foreign Countries of Patent Application
(1) (a) Name of Inventor (Last, First, MI) NONE	NONE
(b) Name of Employer	
(c) Address of Employer (Include ZIP Code)	

SECTION II - SUBCONTRACTS (Containing a "Patent Rights" clause)

6. SUBCONTRACTS AWARDED BY CONTRACTOR/SUBCONTRACTOR (If "None," so state)	7. SUBCONTRACTS AWARDED BY CONTRACTOR/SUBCONTRACTOR
a. NAME OF SUBCONTRACTOR(S)	a. NAME OF SUBCONTRACTOR(S)
b. ADDRESS (Include ZIP Code)	b. ADDRESS (Include ZIP Code)
c. SUBCONTRACT NO(S)	c. SUBCONTRACT NO(S)
d. DIAR "PATENT RIGHTS" (1) Clause Number (2) Date (YYMM)	d. DIAR "PATENT RIGHTS" (1) Clause Number (2) Date (YYMM)
e. DESCRIPTION OF WORK TO BE PERFORMED UNDER SUBCONTRACT(S)	e. DESCRIPTION OF WORK TO BE PERFORMED UNDER SUBCONTRACT(S)
f. SUBCONTRACT DATES (YYMMDD) (1) Award (2) Estimated Completion	f. SUBCONTRACT DATES (YYMMDD) (1) Award (2) Estimated Completion

SECTION III - CERTIFICATION Signatures

7. AUTHORIZATION OF REPORT BY CONTRACTOR/SUBCONTRACTOR NAME OF AUTHORIZED CONTRACTOR/SUBCONTRACTOR OFFICIAL (Last, First, MI) Lee D. Beatty	8. SIGNATURE OF CONTRACTOR/SUBCONTRACTOR NAME OF CONTRACTOR/SUBCONTRACTOR Grant & Contract Admin.
9. TITLE Principal Investigator	9. TITLE Contracting Official
10. SIGNATURE A. F. St. Mary	10. SIGNATURE A. F. St. Mary
11. DATE 1988	11. DATE 1988